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Influence of hollow carbon microspheres with micro and nano-scale on the physical and mechanical properties of epoxy syntactic foams

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In this paper, based on the surface structure analysis of HCMs, the effects of hollow carbon microspheres with micro and nano-scale on the mechanical properties, dimensional stability, thermal conductivity, thermal stability and dielectric properties of epoxy foam were investigated by using various techniques.

To avoid the effect of chemical reagent on the analysis results, the purified and dried hollow carbon microspheres were used, and no other surface treatments were carried out in the paper. In fact, the nano-scale HCM (N-HCM)/epoxy foam samples with different content of N-HCMs have been prepared in the experiments. When the content of N-HCMs was higher than 1wt%, some carbon spheres began to touch each other, and formed local aggregations which can seriously affect the performance of the foam materials, as shown in Fig.S1.

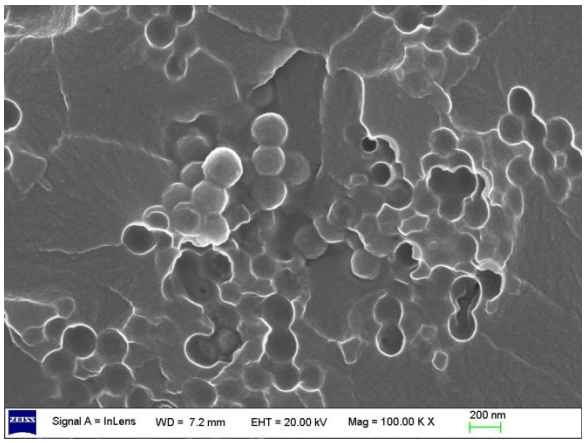
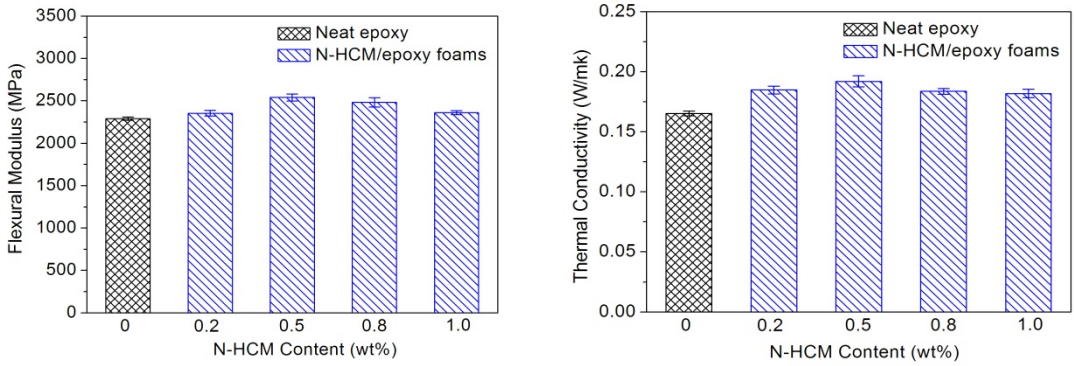
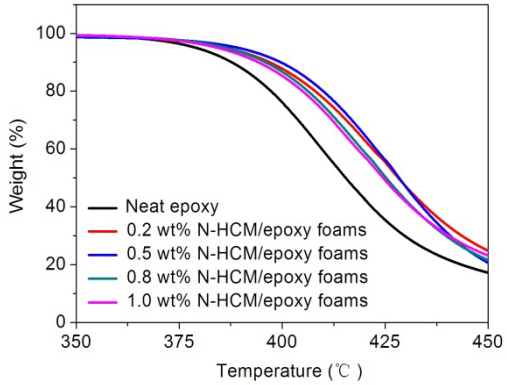


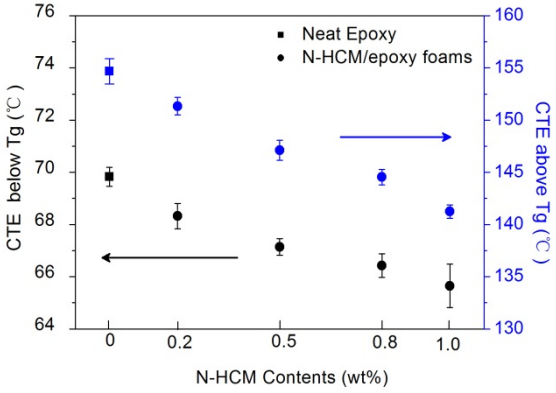
Fig S1. The aggregation of N-HCMs in 1.5wt% N-HCM/epoxy foams

Considering the effect of aggregation of nanoparticles in polymer matrix, some epoxy samples with low content of N-HCMs were used for performance analysis. The effects of N-HCM content (0, 0.2, 0.5, 0.8, 1wt%, respectively) on the mechanical properties, dimensional stability, thermal conductivity, and thermal stability of epoxy foams were studied, as shown in the Fig.S2. It can be seen that 0.5wt% N-HCM/epoxy foams exhibited the optimal comprehensive performance among all N-HCM/epoxy samples. With the further increase of N-HCM content, the comprehensive performance of epoxy foam samples was declined due to the formation of small amounts of N-HCM aggregations in polymer matrix.



(a) Flexural modulus (b) Thermal conductivity





Thermal stability (d)

Dimensional stability

Fig S2. Some representative properties of N-HCM/epoxy foam samples

Notes and references

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